

CALIFORNIA DIVISION OF MINES AND GEOLOGY

FAULT EVALUATION REPORT FER-106

March 16, 1981

1. Name of fault:

SE segment of Hayward fault, Evergreen fault, Quimby fault, Silver Creek fault, and Piercy fault.

2. Location of fault:

San Jose East and Lick Observatory 7.5 minute quadrangle^s, Santa Clara County (figure 1).

3. Reason for evaluation:

Part of 10-year fault evaluation plan (Hart, 1980).

4. References:

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- Herd, D.G. (in press), Map of principal late Quaternary Faults, San Francisco Bay Region, California: U.S. Geological Survey Miscellaneous Field Studies Map, scale 1:250,000 (faults compiled for FER-106 based on 1:24,000 work map).
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- Terrasearch, 1978a, Geologic investigation on 42 acre residential development north of Mt. Pleasant Road and Westview Drive, Santa Clara County, California: unpublished consulting report (AP-1064).
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5. Review of available literature, air photo interpretation, and field checking:

The southern extension of the Hayward fault zone (figure 1) will be evaluated in two Fault Evaluation Reports (FER) divided as follows: Milpitas and Calaveras Reservoir 7.5 minute quadrangles, FER-105, and San Jose East and Lick Observatory quadrangles, FER-106 (this report). Evaluation of the Calaveras fault zone will not be included in these FER's.

The Hayward fault zone in the San Jose East and Lick Observatory quadrangles consists of both right-lateral strike-slip and reverse oblique displacement that occurs in a complex zone up to 8,000 feet wide (figures 2a, 2b). Topography along the fault zone ranges from gently sloping surfaces in the western portion of the study area to rugged relief along the main trace of the Hayward fault. Land surfaces along much of the west portion of the fault zone have been extensively modified by man, either because of urbanization in the northern part of the study area or agricultural use in the central and southern part of the study area. Widespread Holocene and historic landsliding characterizes many of the west-facing slopes where the Hayward and Quimby faults have been mapped (figures 3a, 3b).

Lithology encountered along the fault zone includes rocks of the Franciscan Formation (including extensive outcrops of serpentine in the Silver Creek area), Jurassic and Cretaceous sandstone, shale and conglomerate, Tertiary sedimentary rocks (Orinda, Briones, and Monterey Formations), and Plio-Pleistocene Santa Clara Formation. Extensive, locally thick deposits of late Pleistocene and Holocene alluvium blanket much of the western portion of the study area. Many

of these formations have been internally sheared and deformed during a number and variety of geologic events, including, but not limited to, deformation caused by movement along the Hayward fault zone.

A number of site - specific fault investigations have been performed along traces of the Hayward fault zone in the San Jose East quadrangle. Results of these investigations along the Evergreen fault ^{zone} commonly have been inconclusive or contradictory, due in part to the complex nature of the fault zone and the relatively rapid and extensive deposition of alluvium during late-Pleistocene and Holocene time.

Hayward Fault

The Hayward fault depicted on the 1974 Special Studies Zones Maps (SSZ) of the San Jose East and Lick Observatory 7.5 minute quadrangles is based on mapping by Dibblee (1972a, 1972b) (figures 2a, 2b).

The Hayward fault is relatively well-defined in the San Jose East and Lick Observatory quadrangles and is characterized by systematic, large scale deflection of drainages consistent with right-lateral displacement. Associated scarps, closed depressions, linear drainages, and tonal lineaments in late-Pleistocene and Holocene deposits also characterize the fault (figures 3a, 3b). The discontinuous nature of the geomorphic expression of this fault zone may be due in part to the extensive landsliding characteristic of the eastern part of the study area (Dibblee, 1972a, 1972b; Nilsen, 1972; Herd, in press) (figures 3a, 3b).

Herd (in press) has mapped late Quaternary traces of the Hayward fault on the San Jose East and Lick Observatory quadrangles (figures 2a, 2b). The Hayward fault is mapped as concealed by landslide deposits along most of its trend in the San Jose East quadrangle (Herd, in press) (figure 2a). Herd shows traces of the Hayward fault offsetting late-Pleistocene and Holocene (?) deposits of Dibblee (1972b) in the Yerba Buena Creek area (figure 2b). South of Yerba

Buena Road the Hayward fault is characterized by discontinuous traces trending more to the southeast until Las Animas Creek where the Hayward fault joins the Calaveras fault zone (Herd, in press) (figure 2b).

One A-P fault investigation involving trenching (Terrasearch, 1978c) was conducted east of a concealed trace of the Hayward fault (Dibblee, 1972a) (figure 2a). Evidence for faulting was not observed.

Air photo interpretation by this writer of traces of the Hayward fault in the San Jose East and Lick Observatory quadrangles is summarized on figures 3a and 3b. Generally, fault traces by this writer agree with traces by Dibblee (1972a, 1972b) and Herd (in press), although differences in detail exist (figures 3a, 3b). Geomorphic evidence of Holocene faulting exists in the northernmost portion of the San Jose East quadrangle (region of Pueblo Lands) where the fault is defined by a linear drainage associated with a west-facing scarp and tonal lineaments in possible Holocene alluvium (Qa of Dibblee, 1972a). A well-defined linear trough with associated right-laterally deflected drainages, tonal lineament in Holocene (?) alluvium, beheaded drainages, closed depressions, and possible sidehill bench indicates Holocene-active faulting (figure 3a). Geomorphic features indicating Holocene faulting in the region of Norwood Creek include a back-facing scarp and tonal lineament associated with a closed depression of possible fault origin (closed depression, on trend with Hayward fault, is within landslide deposits) (figure 3a).

Well-defined fault traces were observed on the Lick Observatory quadrangle between Fowler Creek and Mt. Misery (figure 3b). Well-defined geomorphic features indicating Holocene faulting along Yerba Buena Road include: systematic right-laterally deflected drainages, scarp and associated ponded alluvium (closed depression?), closed depression with associated fault scarps about 2,000 feet east of the small reservoir, and east-facing scarp in deposits Dibblee (1972b) mapped as Holocene, Nilsen (1972) mapped as colluvium of unspecified (late

Quaternary?) age, and late-Pleistocene age older fan deposits of Helley and Brabb (1971) (figure 3b).

The southeast-trending faults of Herd (in press) south of hill 1455 are generally vaguely-defined by geomorphic features indicating possible Pleistocene(?), but probably not Holocene faulting, based on brief air photo interpretation by this writer (figure 2b). West of Mt. Misery Herd's fault traces are defined by a broad, somewhat modified trough (erosional?), vague tonal lineaments, and a sidehill bench (?) parallel to the existing drainage (sidehill bench could be river terrace) (figure 2b). South and southeast of Mt. Misery linear drainages define Herd's traces (figure 2b). West of Las Animas Creek three subparallel linear troughs are generally transverse to the slope. Herd maps only the northern trough. However, saddles west of the northernmost trough may indicate resistant bedding rather than faulting. Dibblee (1972b) maps a fault in this location, but the fault is within Knoxville Formation, and may be an old bedding plane fault. The linearity of Las Animas Creek may be due to erosion, although a vague tonal lineament coincides with the easternmost, linear part of the creek (figure 2b).

The relatively straight west-northwest trend of Thompson Creek indicates that recent right-lateral offset along the Hayward fault does not extend south of Mt. Misery (figure 3b).

Evergreen Fault

The Evergreen fault depicted on the 1974 SSZ Maps of the San Jose East and Lick Observatory quadrangles is based on mapping by Dibblee (1972a, 1972b). Dibblee mapped the Evergreen fault based on an exposure in Yerba Buena Creek where Jurassic/Cretaceous Knoxville shale is faulted ^{over} Holocene alluvium (NE side up) (figure 2a). Alluvial fan deposits mapped by Dibblee as Holocene are also vertically offset by the Evergreen fault in Yerba Buena Creek. About 3 miles northwest of Yerba Buena Creek a west-facing scarp east of the Pleasant Hills golf course offsets

material Dibblee mapped as late-Pleistocene older alluvium over Holocene alluvium. Dibblee interpreted this feature to be an exposure of the Evergreen fault and mapped a queried, concealed fault between these two exposures, based on knobs of Cretaceous bedrock exposed in alluvium (figure 2a). Dibblee extended the Evergreen fault to the north, based on the apparent vertical offset of older alluvium near the Mt. Pleasant School and the general alignment of the alluvium bedrock contact along Clayton Road.

Herd (in press) mapped late-Quaternary traces of the Evergreen fault on the San Jose East quadrangle, and for about 1,000 feet onto the Lick Observatory quadrangle (figure 2a, 2b). Evergreen fault traces of Herd are delineated as well-defined but discontinuous, somewhat sinuous east-dipping thrust faults. Herd's mapping agrees with Dibblee in the Yerba Buena Creek area, but to the north Herd depicts a much more complex zone of compression (figure 2a).

Air photo interpretation by this writer indicates that the Evergreen fault is complex and discontinuous, but locally well-defined (figures 3a, 3b). Modified west-facing scarps in older alluvium (late-Pleistocene?) associated with weak tonal lineaments define the Evergreen fault in the Babb Creek area east of Alum Rock Avenue (figure 3a). A modified SW-facing escarpment parallel to Clayton Road was trenched by Soil Foundations Systems (1977), but evidence of faulting was not observed (figure 3a). East of Mt. Pleasant School a sharp right-laterally deflected drainage associated with a SW-facing scarp coincides with an inferred fault Dibblee mapped as offsetting late-Pleistocene age alluvium (figures 2a, 3a).

Northeast of Mt. Pleasant Road, well-defined west-facing scarps offset an alluvial fan surface that is probably Holocene in age. Helley and Brabb (1971) indicate that most of the alluvial fans bordering the west-facing slopes in this region are late-Pleistocene. However, the age of at least some of these alluvial fans may be Holocene, based on a ^{14}C date from a site just north of Fowler Road (figure 3a). A piece of wood exposed in a trench at a depth of 6 feet was dated at $5,397 \pm 310$ yrsBP (H. Minch, p.c., January 1981). This location is about $2 \frac{3}{4}$

miles southeast of the alluvial fan east of Mt. Pleasant Road and a direct correlation of ages is probably not valid. However, the Fowler Road fan surface (assumed by Helley and Brabb to be late-Pleistocene) has an incised stream channel, one criterion used by Helley and Brabb for a late Pleistocene age. The middle Holocene age of this incised alluvial fan suggests that the criterion of an incised channel may not be a valid indication of late-Pleistocene age for all alluvial fans.

Dibblee mapped the deposits east of Mt. Pleasant Road as Holocene, but mapped the Evergreen fault as concealed (figure 2a). Herd mapped well-defined scarps across the fan surface (figure 2a). Fault traces mapped by this writer agree with the traces of Herd in this area although some of the geomorphic features may be erosional (figures 2a, 3a). Associated tonal lineaments and a recently incised drainage further delineate this fault. A fault investigation by Soil Foundations Systems (1974) trenched within about 300 feet of this feature, but did not find evidence for faulting (figure 3a).

South of Kohler Avenue, an interesting, but somewhat perplexing feature is offset by the Evergreen fault (figure 3a). Dibblee mapped this feature as older alluvium and indicates that Tertiary Monterey debris is exposed on the surface of this feature. Allan Binfer (Terratech, 1977) interpreted the feature as a large debris avalanche, and contends that the scarp at the "toe" of this feature is due to landsliding rather than faulting. Sharply deflected drainages south of the feature, plus the roughly "circular" shape in map view led to the interpretation of a landslide origin. However, several A-P - site investigations within the boundaries of this feature have exposed material characteristic of alluvial deposits, with associated sedimentary features such as graded bedding, channeling, and local cross-bedding, to depths as great as 20 feet (Rose, 1974a, 1974b; Cleary and Associates, 1978; Earth Systems Consultants, 1978, Terratech, 1977) (figures 2a, 3a). The feature may have originally formed by landsliding, but the surface subsequently has been altered and a mantle of relatively coarse

alluvial material has been deposited over the surface. The offset of the base, or "toe", of this feature is probably related to faulting rather than landsliding, because the feature seems to extend west of the scarp thought by Binfer to be the "toe" of the landslide (figure 3a). Holocene alluvium onlaps the scarp in the vicinity of a site investigation by Earth Systems Consultants (1978), indicating that the formation of the scarp pre-dates at least mid to late Holocene time. The site investigation by Terratech (1977) did not expose evidence supporting the location of either a fault or a landslide toe (figure 2a, 3a).

A well-defined back-facing scarp with associated beheaded drainages located about 300 feet northeast of the investigation by Cleary and Associates (1978) is permissive of Holocene faulting (figure 3a). However, this feature is short and does not offset the drainage to the southeast and may be related to landsliding rather than faulting. A modified west-facing scarp just east of Ruby Avenue does not seem to be Holocene-active, based on the somewhat eroded scarp, and the lack of a change in gradient along the drainage across the scarp (figure 3a).

South of Norwood Avenue the Evergreen fault is characterized by a bedrock scarp in alluvium (figure 3a). Associated swales and incised drainages suggest late-Pleistocene activity although the swale may be an old stream channel. A site investigation by United Soil Engineering (1975) did not find evidence for faulting in this area, but the results of the investigation generally were inconclusive. A combination of geophysical and subsurface techniques were utilized, including magnetometer, seismic refraction, drill holes, and excavation of three trenches (figure 2a). Evidence from drill holes indicates that alluvial deposits extend to a depth of at least 200 feet west of the outcrop of Cretaceous bedrock. However, the drill holes were located east and west of Dibblee's concealed and queried location of the Evergreen fault (figure 2a). Air photo interpretation by this writer indicates that faulting probably exists about 350 to 400 feet east of Dibblee's trace, so the drill holes do not establish the absence of faulting

(figure 3a). However, three trenches were excavated near the west-facing scarp and faulting was not observed (figure 3a).

Geomorphic evidence for the Evergreen fault was not observed between Quimby Road and Fowler Road, except for an outcrop of bedrock associated with a gentle west-facing scarp (figure 3a). In the vicinity of Fowler road and to the south, a moderately well-defined, but somewhat modified scarp with associated tonal lineaments and vegetation contrasts can be observed (figure 3a). This scarp was trenched by Berloger, Long and Associates (1978) and evidence of late-Pleistocene and possible Holocene offset was observed. Evidence of reverse faulting offsetting late-Pleistocene(?) fan deposits was found. In the same trench (T-3), but about 150 feet east of this shear, an apparent vertical offset of 6 to 8 inches in the uppermost soil layer (west-side up) is thought by Berloger, Long and Associates to represent Holocene right-lateral displacement along this fault zone.

Berloger-Long, using this geomorphic and subsurface evidence, connected right-laterally deflected drainages near Fowler Road and north of Aborn Road along the trace of what they term the "East Evergreen fault" (figure 2a). Well-defined tonal lineaments, scarps, troughs or closed depressions are not associated with these deflected drainages (figure 3a). Berloger-Long argues that the consistent amount of offset of these two drainages indicates faulting, and a third right-laterally deflected drainage just south of the 1978 investigation area further supports the faulting interpretation (figure 2a). The "East Evergreen fault" extends south to Montgomery Hill where the trace joins Dibblec's trace of the Evergreen fault (figure 2a). However, there is no geomorphic evidence supporting the existence of an active fault through the low hills just north of Montgomery Hill (figure 3a). Ridges are not offset; scarps, sidehills benches, or troughs are not present (figure 3a). The right-lateral deflection of the drainage is more likely caused by relatively resistant bedrock rather than faulting. An abandoned, alluvial filled drainage just south of this deflected drainage suggests that recent uplift along the Evergreen fault deflected this

drainage around the uplifted knoll of bedrock (figure 3a).

Evidence for tectonic fault creep across Aborn Road and distress to the Borollo residence is cited by Berloger-Long as further evidence for Holocene faulting along the "East Evergreen fault" (figure 2a). However, convincing evidence mandatory of right-lateral strain was not observed during a field check in May, 1979 by E. Hart and this author. Differential settlement also could form the distress observed. A site investigation adjacent to Aborn Road by Berloger-Long was completed in 1980 (figure 2a). Evidence permissive of faulting was reportedly observed in a trench south of and parallel to Aborn Road (figure 2a). Vertical shears in clay and silty clay alluvium near the bottom of the trench were associated with vertically aligned pebbles and a possibly truncated gravel lens (G. Reid, p.c., 1981). Slickensides were present, but striations indicating sense of displacement were not observed. Magnitude and sense of offset were not possible to determine due to the poorly defined stratigraphy exposed in the trench (Reid, p.c., 1981). Additional trenches between Aborn Road and Fowler Road did not reveal evidence of faulting.

A well-defined southwest-facing fault scarp permissive of Holocene faulting can be observed along the south flank of Montgomery Hill (figure 3a). Dibblee (1972a) mapped the Evergreen fault at this location, based on the vertical offset of Jurassic/Cretaceous rocks over Holocene alluvium. The southwest-facing scarp is less well-defined northwest of Yerba Buena Creek. Cooper-Clark and Associates (1972) found evidence of offset along the Evergreen fault near Yerba Buena Creek (figure 3a). Plio-Pleistocene Santa Clara Formation was offset, but evidence of offset soil was not observed. Cooper-Clark postulated right-lateral offset along a near vertical fault, and did not rule out the possibility of faulting extending into the soil.

Dibblee (1972b) mapped the Evergreen fault along Yerba Buena Creek to the east, but except for a possible scarp associated with a tonal lineament, geomorphic evidence for the projection of this fault was not observed (figure 3b).

Quimby Fault

The Quimby fault depicted on the 1974 SSZ Maps of the San Jose East and Lick Observatory quadrangles is based on mapping by Dibblee (1972a, 1972b) (figures 2a, 2b). Much of the Quimby fault of Dibblee is concealed by alluvium and only a few exposures of the fault in Cretaceous or Tertiary bedrock have been mapped. Oblique slip characterizes the Quimby fault with both right-lateral and vertical displacement, east side up (Dibblee, 1972a, b) (figure 2a).

Thirteen A-P fault investigations have been conducted across or near Dibblee's trace of the Quimby fault (figure 2a). Although faulting in Mesozoic or Tertiary bedrock was occasionally observed, no evidence for Holocene, or even late-Pleistocene faulting was observed. Trenches by Terrasearch (1978a), Bay Soils (1977), and Applied Soil Mechanics (1977) crossed a prominent tonal lineament NE of Mt. Pleasant Road and exposed evidence of late-Pleistocene faulting (figure 3a). Bay Soils (1977) located a NE-dipping reverse fault that offset Santa Clara Formation over older alluvium, indicating at least late-Pleistocene activity. However, the faults exposed did not coincide with the tonal lineament and geomorphic evidence of Holocene faulting was not observed, based on air photo interpretation by this writer.

Herd (in press) did not find geomorphic evidence for late Quaternary offset along the Quimby fault, except for a north-south trending fault south of Yerba Buena Creek (figure 2b). Air photo interpretation by this writer confirms the presence of a well-defined west-facing scarp where Dibblee and Herd show faulting (figure 3b). Dibblee (1972b) maps the offset units as Holocene fan deposits and Nilsen (1972) maps them as Qal. This fault cannot be followed north of Bench Mark Kuhn, but seems to step to the right and joins the main trace of the Hayward fault (Herd, in press) (this report, figure 3b). This well-defined fault trace may be part of the Hayward fault rather than the Quimby fault, and will be considered as a trace of the Hayward fault in this report. Farther south, discontinuous fault traces are defined principally as linear drainages, saddles, and tonal

lineaments in Plio-Pleistocene Santa Clara Formation, and evidence mandatory for Holocene faulting was not observed (figure 3b).

A modified, southwest-facing scarp about 1500 feet north of Yerba Buena Road was trenched in August 1980 by Earth Sciences, Associates (figure 3a). A low-angle, NE-dipping fault coincident with the scarp offset a paleosol estimated to be >70,000 years old, but did not extend into the overlying colluvium and topsoil. The trench crossed the mapped trace of the Quimby fault and no evidence of faulting was observed.

Silver Creek Fault.

The Silver Creek fault, depicted on the 1974 SSZ Maps of the San Jose East and Lick Observatory quadrangles, is based on mapping by Dibblee (1972a, 1972b) and Fugro (1973). The Silver Creek fault was zoned because of the offset of Plio-Pleistocene Santa Clara Formation against serpentine and Franciscan Melange.

The Silver Creek fault is generally characterized by a linear stream valley and associated linear ridges developed in Santa Clara Formation. Well-defined fault features generally were not observed along the trace of the Silver Creek fault, except for short, discontinuous tonal lineaments in Santa Clara Formation and Holocene alluvium (figure 3a). A very linear, well-defined trough west of and parallel to Thompson Creek is in Santa Clara Formation, but additional fault features were not observed. The geomorphic expression of this feature could also be caused by resistant bedding.

Extremely vague tonal lineaments define a trace of the Silver Creek fault about 1,000 feet east of the main trace (figure 3a). This lineament was trenched by United Soil Engineering (1977a) and faulting interpreted to be right-lateral strike-slip was exposed. The fault offsets older alluvium and possibly colluvial deposits (?), but doesn't extend into the uppermost soil horizon. United Soil Engineering interprets the offset material on the southwest side of the fault as part of a continuous soil horizon, but the description of material exposed in the trench is insufficient to evaluate whether the material on the southwest side of

the fault represents a continuous, well-developed soil horizon, or possibly colluvial deposits.

Applied Soil Mechanics (1976b) exposed evidence permissive of faulting near the mouth of Silver Creek (figure 2a). A monoclinal warp involving the thickening of older alluvial deposits (?) indicates late Pleistocene ^{are} faulting. Overlying gravels and soil ~~is~~ ^{are} not offset.

Possible evidence of fault creep along the Silver Creek fault is located near the power line easement at the mouth of Silver Creek (R.O. Burford, p.c., December 1979). A fence line is deformed in an apparent right-lateral sense in a zone about 250 feet wide (figure 3a). Offset may be as much as 6 inches (measured in 1971, Burford, p.c., 1979). The age of the fence line is somewhat uncertain, but was built sometime between 1948 and 1958. Burford states that evidence is rather tentative and continued monitoring of the fenceline is not possible because of the replacement of gates (with poor alignment) at two localities.

Construction of power lines across this fenceline began about 1950, based on U.S.D.A. (1950) air photos. The U.S.D.A. photos show preliminary grading along the power line alignment coincident with the location of the offset fenceline segment Burford surveyed. The construction of the towers had not yet begun. The fence seems to be present in the 1950 U.S.D.A. air photos, based on the straight, unpaved path or road along the fence alignment and the abrupt change in cultivation on either side of the fence alignment. Assuming that the fence existed at the time of power line construction, it is probable that a segment of the fence was removed to facilitate construction of the power line towers. Replacement of the segment of fence removed during construction may not have been carefully aligned. When Burford surveyed the fence line in 1971, it may not have been apparent where a replaced segment of the fence might have been, due to the length of time the replaced segment of the fence had been exposed to weathering. Geomorphic

evidence of faulting coincident with apparent fence line offset was not observed by this writer, based on air photo interpretation..

Lowney-Kaldveer Associates (1971) indicates two locations ^hwhere possible evidence of fault creep was observed along the Silver Creek fault (figure 3a). A nail alignment in Aborn Road was installed ⁱⁿ1969 and surveyed sometime before 1971 (figure 5). Possible right-lateral displacement of 4mm was observed, but other areas in this alignment show almost the same magnitude of offset. Cracks and the resulting migration of asphalt in Aborn Road may be the cause of the apparent offset. Continued monitoring of this nail alignment has not been performed. Fault features associated with the alignment array have not been observed. Lowney-Kaldveer also observed an apparent right-lateral offset of a fence crossing the Silver Creek fault about 3,000 feet southeast of the fence line Burford surveyed (figure 3a).

no ff (The point area of offset is near a southwest-facing slope and could also be caused by soil creep (W.A. Wahler and Associates, 1972).

Systematic evidence of fault creep along the northwest projection of the Silver Creek fault was not observed by Lowney-Kaldveer, except for isolated, non-systematic curb offsets.

Geomorphic evidence of Holocene faulting southeast along the trace of the Silver Creek fault is either expressed by vague tonal lineaments or is concealed by Holocene landslides (figure 3a, 3b). The west trace of the Silver Creek fault, mapped as a west-dipping thrust fault by Dibblee (1972a), is concealed by landsliding (Nilsen, 1972; this report, figure 3a). Most of the Silver Creek fault shown on the Lick Observatory quadrangle is concealed by landsliding and no geomorphic evidence of Holocene faulting was observed (figure 3b).

Piercy Fault

The Piercy fault depicted on the 1974 SSZ map of the San Jose East quadrangle is based on Dibblee (1972a) (figure 2a). Dibblee mapped the Piercy fault based on an exposure of serpentine faulted against Santa Clara Formation.

No geomorphic evidence of Holocene active faulting was observed along the trace of the Piercy fault^g, based on brief air photo interpretation by this writer (figure 3a). The fault is generally located along a poorly-defined break in slope and forms the contact between the Santa Clara Formation and serpentine. Evidence of recent offset, such as incised drainages, well-defined scarps, or tonal lineaments, was not observed. Dibblee maps the fault ^gwas concealed beneath alluvium along most of its trace (figure 2a).

6. Conclusions:

The southern extension of the Hayward fault zone is characterized by an extremely complex zone of compressional features comprised of both right-lateral strike-slip and reverse to reverse oblique faulting.

Hayward Fault

The Hayward fault in the San Jose East quadrangle is locally well-defined and is delineated by large scale, systematic right-laterally deflected drainages (figure 3a,3b). However, geomorphic evidence of Holocene faulting is obscured by landslides along some segments of the fault (figure 3a). Geomorphic evidence of Holocene faulting was observed in the Flint Creek area where a well-defined linear trough associated with tonal lineaments in Holocene (?) alluvium, closed depression and beheaded drainage were aligned with right-laterally deflected dra^aing^aes (figure 3a). Additional geomorphic evidence permissive of Holocene faulting was observed north in the Pueblo Lands area and south in the Norwood Creek area (figure 3a). Herd (in press) also shows traces of th^e Hayward fault in these areas, although he has mapped them mainly as concealed (figure 2a).

Well-defined geomorphic evidence of Holocene faulting is found in the Yerba Buena Creek area on the Lick Observatory quadrangle (figures 2b, 3b).

Hayward fault traces of Dibblee (1972a, 1972b), Herd (in press), and Bryant

(figures 3a, 3b, this report) generally agree, although evidence for the continuous traces of Dibblee could not be found. No evidence of Holocene faulting along the concealed east trace of Dibblee (1972a) was observed.

Evergreen Fault

The Evergreen fault of Dibblee (1972a) depicted on the 1974 SSZ Map of the San Jose East quadrangle is only a generalization of a complex fault zone. The Evergreen fault is a complex reverse-oblique fault, ^{that} has possible evidence of a component of right-lateral slip during Holocene time (Cooper-Clark, 1972; Berloger, Long and Associates, 1978). Well-defined but discontinuous fault scarps permissive of reverse faulting during Holocene time ^{were} ~~was~~ observed in the Yerba Buena Creek area, and south of Fowler Road (figure 3a). Well-defined west-facing scarps offset an alluvial fan surface of possible Holocene age east of Mt. Pleasant Road (figure 3a).

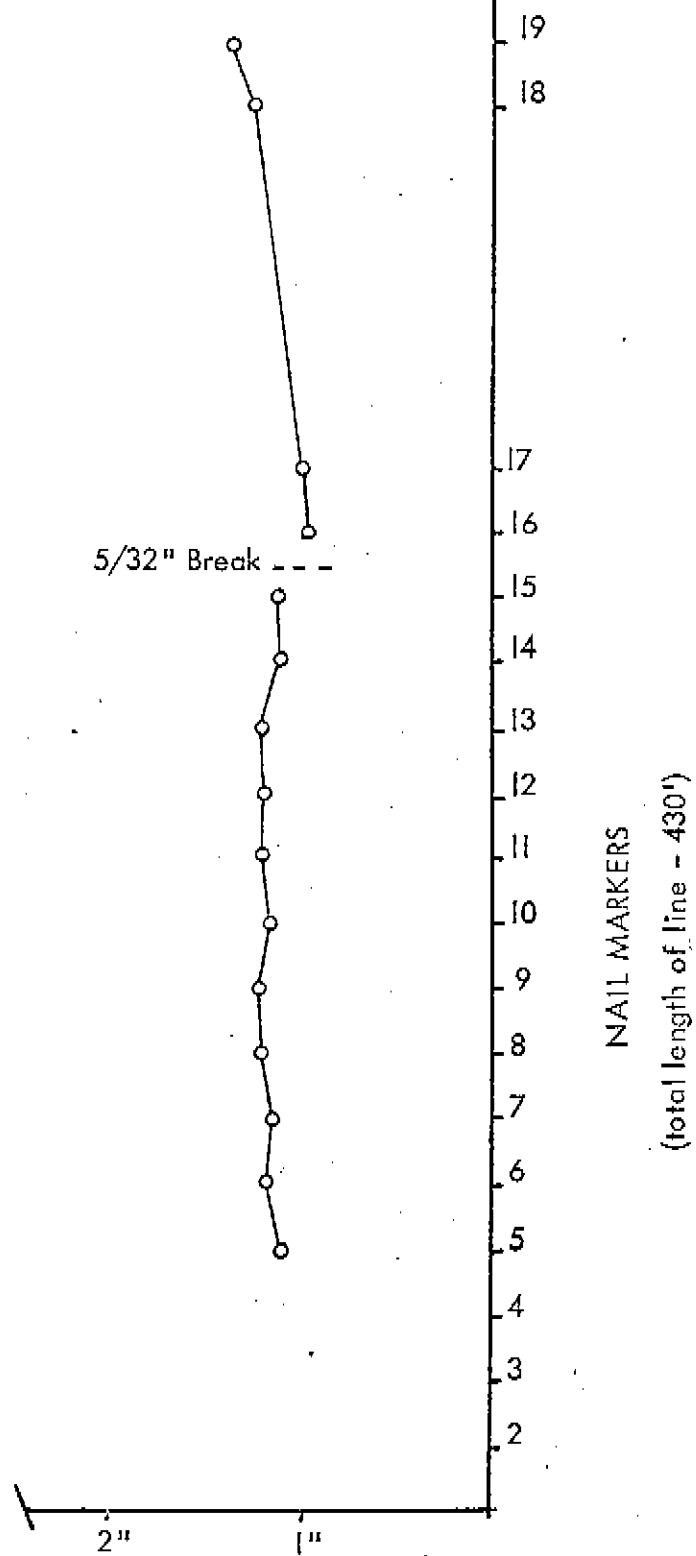
Results of A-P fault investigations along traces of the Evergreen fault are contradictory. No evidence of faulting was found by Terratech (1977) across a moderately well-defined west-facing scarp east of the Pleasant Hills golf course (figure 3a). United Soil Engineering (1975) did not find evidence of faulting south of Norwood Avenue along Dibblee's trace of the Evergreen fault.

Geomorphic evidence for the "East Evergreen fault" of Berloger, Long and Associates (1978) cannot be found north of Fowler Road. Tectonic creep reported along Aborn Road exposed evidence permissive, but not mandatory, of faulting. The projected "East Evergreen fault" north of Aborn Road is not supported by geomorphic evidence.

Selected traces of the Evergreen fault mapped by Berloger, Long and Associates (1978), Bryant (figure 3a, this report), and Dibblee (1972a) delineate well-defined traces of the Evergreen fault, but probably do not delineate all traces of this complex fault zone.

Quimby Fault

Geomorphic evidence of Holocene faulting was not observed along traces of the



LOCATION: Aborn Rd. near Capitol Expressway

Figure 5 (to FER-106). Plot of NOAA nail alignment resurvey along Aborn Road (Lowney-Kaldveer and Associates, 1971).

Quimby fault. A-P fault investigations across traces of the Quimby fault have exposed evidence of faulting in Mesozoic and Tertiary bedrock, but evidence for Holocene faulting has not been found (figures 2a, 2b). A well-defined fault south of Yerba Buena Creek was mapped by Dibblee as part of the Quimby fault, but the fault is considered by this writer to be a segment of the main trace Hayward fault (figure 3b).

Silver Creek Fault

Geomorphic evidence for Holocene offset along the Silver Creek fault is vague in detail. The fault zone is primarily defined by a very linear valley and associated linear ridges in Plio-Pleistocene Santa Clara Formation to the northeast faulted against serpentine and Franciscan Melange. A site investigation by United Soil Engineering (1977) located a fault with evidence of late-Pleistocene offset, but overlying Holocene soil was not offset. Possible historic fault creep along the Silver Creek fault is suggested by the apparent right-lateral displacement of fence lines (Burford, p.c., 1979; Lowney-Kaldveer Associates, 1971) but evidence mandatory of fault related deformation and associated geomorphic fault features were not observed.

No geomorphic evidence of Holocene faulting was observed along the mapped trace of the Silver Creek fault in the Lick Observatory quadrangle. Much of the area is covered with massive landslides (Nilsen, 1972; figure 3b, this report).

Herd (in press) does not show late Quaternary traces of the Silver Creek fault.

Piercy Fault

Geomorphic evidence of Holocene faulting was not observed along the Piercy fault of Dibblee (1972a), and Dibblee does not map the Piercy fault as offsetting Holocene alluvium. Herd (in press) does not show late Quaternary traces of the Piercy fault.

7. Recommendations:

Recommendations for zoning faults for special studies are based on the criteria of sufficiently active and well-defined (Hart, 1980).

Hayward Fault

Zone for Special Studies well-defined traces of the Hayward fault mapped on the San Jose East and Lick Observatory quadrangles by Dibblee (1972a, 1972b), Herd (in press), and Bryant (figure 3a, 3b; this report) (figures 4a, 4b). Delete the concealed and inferred east trace of Dibblee (1972a) on the San Jose East quadrangle.

Evergreen Fault

Modify traces of the Evergreen fault based on well-defined fault traces mapped by Dibblee (1972a), Berloger, Long and Associates (1978), and Bryant (figure 3a) shown on figures 4a and 4b. Delete the concealed and queried trace of Dibblee (1972a). The trace of Berloger, Long and Associates' "East Evergreen fault" north of Fowler Road is not well-defined and evidence mandatory of right-lateral fault creep was not observed at the Borello residence on Aborn Road.

Quimby Fault

Delete traces of the Quimby fault on the San Jose East and Lick Observatory quadrangles. This fault is not sufficiently active and well-defined, except near Yerba Buena Creek where traces are considered to be ^{a part} ~~aprt~~ of the Hayward fault.

Silver Creek Fault

Delete traces of the Silver Creek fault shown on the San Jose East and Lick Observatory quadrangles. This fault does not offset Holocene deposits and is not well-defined in detail.

Piercy Fault

Delete the trace of the Piercy fault shown on the 1974 SSZ Map of the San Jose East quadrangle. This fault is not sufficiently active and well-defined.

8. Report prepared by William A. Bryant, March 16, 1981.

William A. Bryant

*I concur with
the recommendations.
EAB
3/30/81*

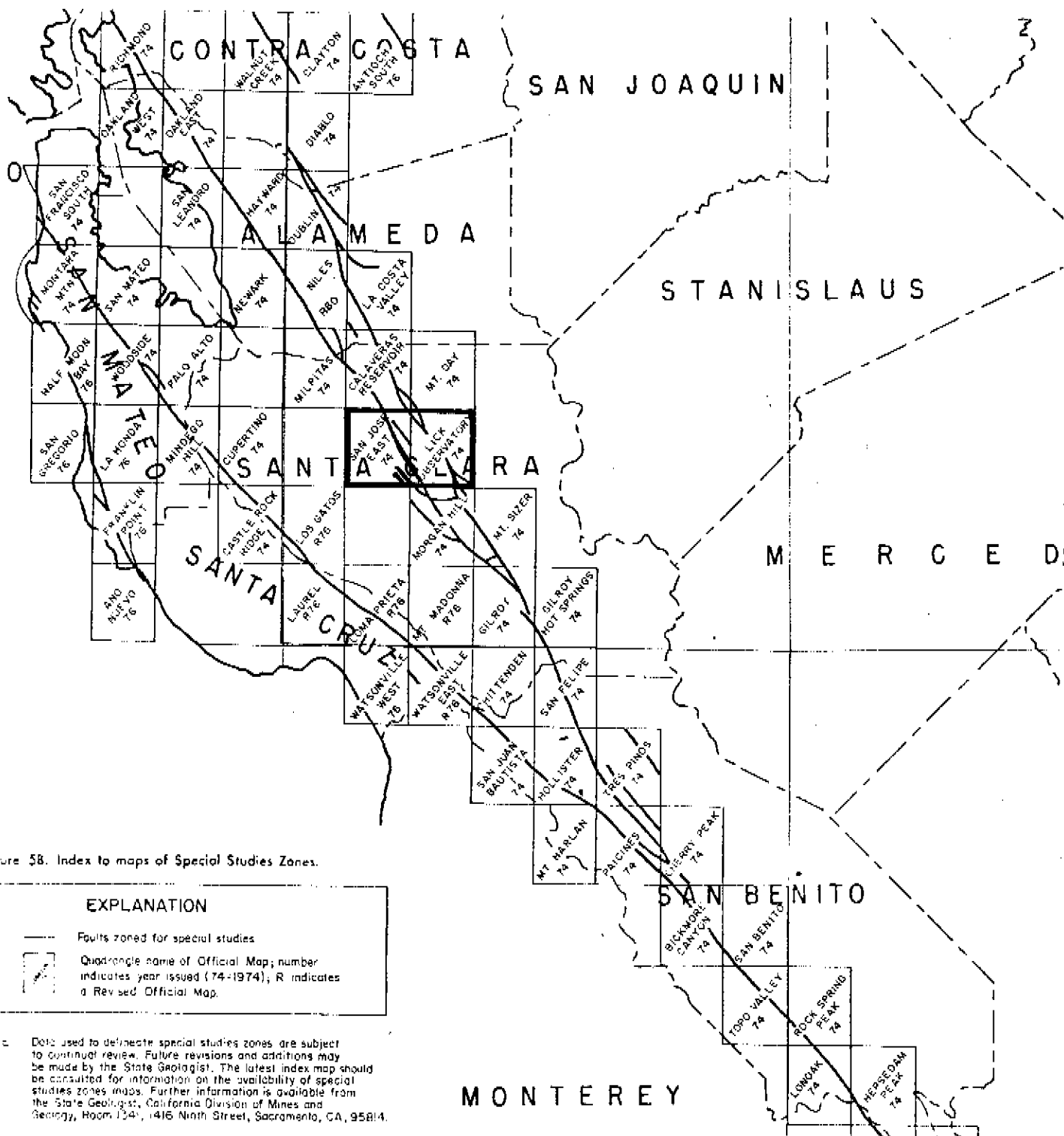


Figure 1 (to FER-106). Location of Hayward fault zone (shown in green) to be evaluated in this FER. Map from Hart (1980, p. 13).